



#### Game Theory Course: Jackson, Leyton-Brown & Shoham

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Pareto Optimality

# Analyzing Games



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- From the point of view of an outside observer, can some outcomes of a game be said to be better than others?

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- From the point of view of an outside observer, can some outcomes of a game be said to be better than others?
  - can't say one agent's interests are more important than another's
  - imagine trying to find the revenue-maximizing outcome when you don't know what currency is used to express each agent's payoff
- Are there ways to still prefer one outcome to another?

- Idea: sometimes, one outcome o is at least as good for every agent as another outcome o', and there is some agent who strictly prefers o to o'
  - in this case, it seems reasonable to say that o is better than o'
  - we say that *o* Pareto-dominates *o*'.



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An outcome  $o^*$  is Pareto-optimal if there is no other outcome that Pareto-dominates it.



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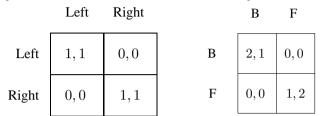
- can a game have more than one Pareto-optimal outcome?
- does every game have at least one Pareto-optimal outcome?



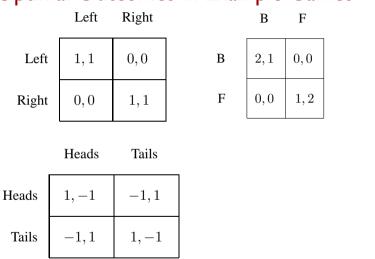
Left Right

Left	1, 1	0, 0
Right	0, 0	1, 1

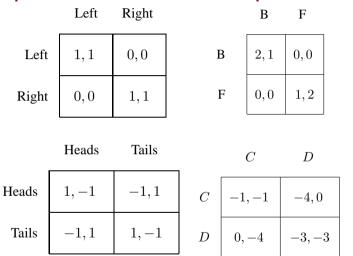




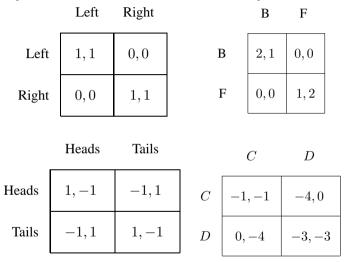




Game region formation and the second second









The paradox of Prisoner's dilemma:

the (DS) Nash equilibrium is the only non-Pareto-optimal outcome!

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